

Implications of the IBM Audio Typing Unit for Blind Word Processors

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In April 1980, Arkansas Enterprises for the Blind (AEB) Rehabilitation Center evaluated the IBM Audio Typing Unit (ATU) created to assist blind or visually impaired typists with proofreading, correcting errors, and making revisions.

The Unit was designed to enable the blind typist to make revisions and review final copy without assistance from sighted co-workers. It works by monitoring a host typewriter and producing electronic speech. Audio responses can supply characters, words, or sentences, including all punctuation, if desired. The device may be used with the standard IBM Mag-Card II, IBM Mag-Card/A or IBM Memory Typewriter.

Specific criteria investigated included (1) the ability of the unit to help the operator proofread and correct errors, (2) the level of operator satisfaction with the unit, (3) the quality of synthetic speech, (4) the time required for the operators to feel comfortable with the unit, (5) the number of typing errors made by the operator over time, and (6) the degree of self-sufficiency and independence exhibited by the blind typist.

Research Design

Five visually impaired students learned the proper use of the IBM ATU from audio tapes developed by IBM. They were also instructed by AEB staff. The testing/training period was 16 hours, with data collected at four-hour intervals. Both students and instructors answered questions designed to measure the effectiveness of the training program (See Figure 1—Trainee Responses and Figure 2—Instructor's Observations). Responses to each item were quantified using a scale of 1-5 (1 = very poor, 5 = very good). By quantifying student and instructor evaluations in this manner, the researchers were able to gather data in three general areas: (1) the total score for all the group tested for all time periods; (2) a score for the group for each time period, thus allowing a trend analysis; and (3) a score for each individual across time and as a function of each criterion. This method of data collection enabled the investigators to measure progress and to assess statistical significance on both an individual and group basis, and to determine whether the previously stated goals and objectives had been achieved.

The rationale for utilizing dual evaluation instruments (Figures 1 and 2) was based on the fact that students could assess the impact of the ATU during their learning, while the instructors could measure the frequencies and types of errors made by the students.

Figure 1. Trainee Responses

(Rate on a scale of 1-5; 1 = very poor, 2 = poor, 3 = average, 4 = good, 5 = very good).	
1. Evaluate the assistance in proofreading	1 2 3 4 5
2. Evaluate the ability to revise or correct your errors	1 2 3 4 5
3. What is the degree of satisfaction with the synthetic speech?	1 2 3 4 5
4. The quality of the voice is	1 2 3 4 5
5. In terms of convenience the placement and operation of the buttons, tabs and controls are	1 2 3 4 5
6. What is your overall evaluation of the equipment?	
7. At this point, what are the operating difficulties that you've observed in the Audio Typing Unit?	
8. Can you envision new applications?	
9. List the changes that you recommend.	

Data Collection Procedure

Figure 3 provides individual and mean group scores of student evaluations on each of those relevant dependent variables investigated. Table 1 and Figures 4 and 5 provide comparable data on

Abstract: *The Audio Typing Unit by IBM was designed to enable visually impaired typists to make revisions and review final copy without the assistance of sighted co-workers. The ability of the unit to do so, based on monitoring the performance of five subjects, is reviewed. The authors state that the unit has a significant impact upon the learning process for visually impaired word processors, and suggest incorporating training on the Audio Typing Unit into vocational rehabilitation programs for blind persons.*

Figure 2. Instructor's Observations

(Rate on a scale of 1-5; 1 = very poor, 2 = poor, 3 = average, 4 = good, 5 = very good).

1. Degree of acceptance of method	1 2 3 4 5
2. Degree of positivity by trainee	1 2 3 4 5
3. Performance trend	1 2 3 4 5
4. Improvement over prior session	1 2 3 4 5
5. Margin adjustment during playback	1 2 3 4 5
6. Scanning	
7. Correcting	1 2 3 4 5
8. Revisions	1 2 3 4 5
9. Proofreading	1 2 3 4 5

Trainee's Scores for this Period

10. Number of errors	_____
11. Time used to correct errors	_____
12. Number of errors not detected by trainee	_____
13. Number of times assistance was sought by trainee	_____

those criteria assessed by the instructor. A review of Table 1 indicates that the assimilation and reporting of data consisted of (1) individual, (2) group, and (3) item analyses for each criterion. This procedure facilitated the analysis and understanding of each student's performance, as well as the differential effects of each criterion investigated.

Analysis of Data

A review of Figure 3 reveals that a linear trend existed in each of the five criteria assessed. As students became more familiar with the operation of the unit, they tended to express more favorable attitudes toward its use. Likewise, in comparing the scores of periods 1 versus period 4, participants rated the quality of voice higher, used the tabs and controls more efficiently, and expressed greater confidence in the unit's ability to provide assistance and revise output in proofreading. Across all criteria assessed in Figure 3, the mean scores obtained after 16 hours of training were significantly higher ($p < .05$) than comparable scores obtained after the first four hours of training.

In analyzing the instructors' evaluation of student performance

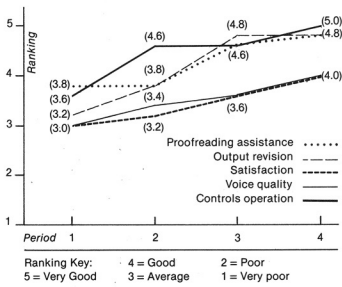


Figure 3. Mean criteria evaluation by trainees (N = 5) across time in areas of proofreading assistance, output revision, satisfaction with synthesized speech, voice quality and controls supervision.

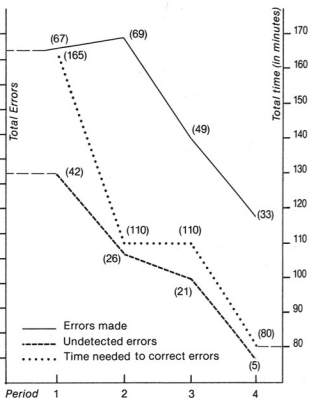


Figure 4. Trainee (N = 5) performance across time for errors made, undetected errors, error correction.

for each criteria shown in Table 1, the scores generally reflect a moderate improvement over time. Compared to Figure 3, the scores recorded in Table 1 indicated considerably less variance as a function of time. While this clustering effect could somewhat limit the generalizations of the current research findings, feedback from instructors reveal that for most criteria assessed, students demonstrated marked improvement in their performance. For example, Table 1 and Figure 4 show a highly significant ($p < .01$) decline in the number of errors made by students after four and 16

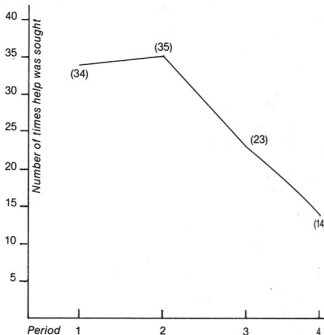


Figure 5. Total number of times help was sought by trainees (N = 5) at each four-hour interval.

Table 1. Analysis of Criteria Evaluation by Instructors (N=5) Across Time

Report Number	Criteria	Raw Scores (1 = very poor; 5 = very good)					Total	Mean
		(1)	(2)	(3)	(4)	(5)		
Degree of Acceptance of Method								
1		3	5	3	4	5	20	4.0
2		3	4	4	3	4	18	3.6
3		4	5	5	5	5	24	4.8
4		3	5	5	5	5	23	4.6
Degree of Positivity by Trainee								
1		3	5	3	5	4	20	4.0
2		3	5	5	5	5	23	4.6
3		4	5	5	5	5	24	4.8
4		3	5	5	5	5	23	4.6
Performance Trend								
1		3	4	4	4	3	18	3.6
2		4	3	5	4	3	19	3.8
3		3	3	3	4	4	17	3.4
4		4	4	4	4	4	16	3.2
Improvement over Prior Session								
1		-	-	-	-	-	-	-
2		4	3	5	3	3	18	3.6
3		3	3	5	5	4	20	4.0
4		4	4	5	4	5	22	4.4
Scanning								
1		-	-	-	-	-	-	-
2		3	2	4	2	3	14	2.8
3		2	3	3	3	3	14	2.8
4		3	3	3	4	4	17	3.4
Correcting								
1		3	4	3	4	3	17	3.4
2		4	4	4	3	4	19	3.8
3		3	4	4	4	3	18	3.6
4		4	4	5	4	4	21	4.2
Revisions								
1		4	4	3	4	3	18	3.6
2		3	4	3	3	4	17	3.4
3		3	4	4	4	4	19	3.8
4		4	4	4	4	4	20	4.0
Proofreading								
1		4	4	4	4	4	20	4.0
2		3	3	3	4	4	17	3.4
3		3	3	5	3	3	19	3.8
4		4	4	5	4	5	22	4.4

hours of training respectively (33 vs. 67). Similarly, the total number of errors not detected by the participants plummeted from 42 to five for the same time period ($p < .01$). Figure 4 also reveals that the average time required to correct errors for the final report period dropped from 33 to 16 minutes per student ($p < .05$). With continued practice, the number of times assistance was sought from the instructor declined significantly ($p < .05$) from 34 to 14 (Figure 5).

In conclusion, blind individuals participating in the study showed increased proficiency in the operation of the ATU and developed greater confidence and receptivity toward this training device. As familiarity with the operation of the unit increased, students showed more independence and enthusiasm. They became more aware of the potential uses of the ATU and assessed its attributes and limitations critically and objectively.

Functional Aspects of the ATU

Because statistics can often obscure and even distort the results obtained in many research projects, the investigators felt that opportunities for including subjective elements of the study should be incorporated into the findings. Some specific points:

- **Adjusting Margins During Playback:** This procedure was bypassed in the instruction. It was found to be cumbersome and

could be replaced by the scan procedure. Adjusting the right margin without the ATU was very difficult for a blind operator. Even with its use, every line that had to be adjusted must be played twice in order to determine where a word had to be hyphenated.

- **Scan:** This capability was found to be extremely valuable for a blind operator. Using the ATU in the Playback On mode, the trainee could learn this procedure very quickly. It took less than three minutes to adjust the right hand margin on a full page of typing. (Adjusting margins during playback took ten to fifteen minutes for the same amount of copy.) Scanning is one of the functions that a blind operator can handle without help.

- **Corrections:** The ATU is extremely helpful in correcting, but at times the blind operator must still depend upon a sighted person to check final copy. There are problems with double letters, words containing *ie*, *ea*, and proper names. However, the great majority of typographical errors can be detected once the operator becomes familiar with the synthetic speech. (See Figure 3.)

- **Revisions:** The blind operator functions almost independently and is easily able to locate the paragraph or line where revisions are to be made. In the past, using the standard Mag-Card, a sighted person would have to stand beside the operator and give instructions to paragraph advance, line advance and advise on the

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A Field Trial of an IBM Audio Typing Unit

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This paper reports on a field trial of a new device, the IBM Audio Typing Unit (ATU) designed to aid blind typists in monitoring their work and correcting errors independently. The ATU monitors a specialized typewriter's production and uses voice synthesizers to generate electronic speech that reads the typed copy aloud. The audio responses can read characters, words, or sentences, including all punctuation, corresponding to the typewriter's keyboard or to type text stored in the host typewriter's memory. The typist can select which information he or she wishes the ATU to report.*

The field trial reported here was designed as a participant observation project in which one author (Ms. Tyler) the supervisor of the Word Processing Center of The New York Association for the Blind (The Lighthouse), explored the use of the ATU in a work environment. This effort was an attempt to help people see how the ATU works and to improve understanding and communication among potential users of a new device.

The Lighthouse Word Processing Center employs three sighted and three blind typists. Sighted typists do copy typing and manuscript work, while the blind typists do transcription work. Line counts of typing produced are kept as one method of evaluating typists' outputs. During the month prior to the installation of the ATU, a log was kept of the amount of time spent by sighted persons in assisting blind workers, by proofreading, for example.

Two blind typists chose to participate in the trial of the ATU. It was decided that they would use the ATU alternately for a week at a time. Each typist used the ATU for a total of six weeks. A daily log was kept of the time spent by sighted workers in aiding the blind typists in correcting their outputs and in other support tasks.

* IBM supplied an ATU for this trial. The ATU can be used with three IBM typewriter models.

Before the installation of the ATU, approximately six to eight hours per week were spent in work support by sighted persons for two blind typists. After the six-week field trial on the ATU, there was no measurable decrease in the amount of time spent by sighted persons in proofreading the blind typists' work and in assisting them in other areas. It was noted that spelling errors did decrease. It was felt that the lack of change in the amount of time spent in sighted persons' support may have been due in part to the method of alternating weeks on the ATU, which meant the blind typists had to refamiliarize themselves each time with the ATU at the beginning of "their week."

The users of the ATU were asked to keep a log of their experiences. A sample of their observations is reported here:

- "It can help you set margins. If I lose my place on a line, I can find it easily without wasting time and paper."
- "If I am typing numbers and happen to hit a wrong key, the ATU will let me know immediately by responding with the number I typed."
- "By the time the ATU was removed I really felt that I was doing a representative day's work proofreading accurately. It was seldom that my supervisor would catch something which I should have picked up on the ATU."
- "Despite some problems, I have found the ATU an extremely good tool for a blind person to use. I myself have run into the problem, when applying for a transcription job, of the employer's unwillingness to hire me simply because I could not see to proofread my own work."

There were some problems reported in the use of the machine:

- "The transposition of letters, character reversals and any other instance where a word would sound strange because of wrong spelling is usually easily picked up by the machine and heard by the typist. However, where combinations of letters are pronounced differently by the machine than they normally are, it can be deceiving."
 - "Another common error not always picked up by the machine is spacing."
- The machine helps correct spelling errors which had been previously undetected:

- "Through the beginning weeks, mistakes were still being discovered that I should have detected by the sound of the ATU. However, within the last few

weeks, it was rare that these types of errors could go undetected by me."

- "Many times the machine's incorrect pronunciation would tell me that perhaps I'd also misspelled a word. I would often discover that indeed the machine had me discover things that I didn't know."

The interrupted schedule of training was a drawback.

- "Although it might have been better to work on the ATU for longer periods, as I became more familiar with the ATU and its ways, going back and forth became far less difficult and I lost less of my skill each time the transition was made."

The work habits of the candidates influenced the manner in which the machine was used. One person, concerned about the amount of work produced, was initially chagrined by the amount of time needed to listen to the ATU. This person tended to use the unit on "punctuation mode," in which the ATU reads out.

The other person, who was more interested in accuracy, tended to use the "spell mode." But, difficulties in concentration interfered with the accurate use of the machine in "spell mode." For instance, more spelling errors appeared near the end of the page than at the beginning of the job. Personality factors and work styles may be important variables to consider when appraising an individual's ability to use the ATU effectively.

The experiences of these typists suggest that the ATU can be helpful. Both of the blind typists who used the ATU were impressed with the proofreading ability of the unit. Both adjusted to the synthetic speech relatively quickly and found that within the six weeks they were able to use the ATU to produce more accurate copy. However, The Lighthouse experience suggests that training with the ATU should be consistent and not interrupted.

One area for further study is the issue of individual response to the ATU, which may well affect training programs and influence the selection of persons to train in the use of the ATU. Finally, the effects of the ATU on productivity need further study and further criteria for measurement should be established.

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location of the word to be deleted or added. With the ATU, this information could be given to the operator on a cassette. The operator will be able to find the location without help.

- **Synthetic Speech:** Those who have already been trained on the Mag-Card before training on the ATU were more comfortable with the host machine and could concentrate more intently on learning the ATU. Those who were trying to learn both the host machine and the ATU at the same time took a little longer. In both cases, however, by the end of the fourth period of instruction, those in both categories found little difficulty understanding the synthetic voice. (See Figure 3.)

- **Operating Host Machine:** The ATU frees blind operators from the fear of making errors. They can concentrate more on the host unit, knowing that they are hitting the proper special mode keys, that they will not run out of ribbon while typing into memory, and will know when the machine stops. Without the ATU, green, amber, and red signal lights on the unit have no meaning unless the operator uses a light probe. It is felt that the verbal instructions associated with the host unit are one of the most important features of the ATU. (See Figure 3.)

- **Proofreading:** When the blind operator is using a headset, proofreading can be accomplished more effectively with the Playback mode on. Errors can be detected while the material is being played back without listening to a line at a time. The versatility of this feature gives the operator better ability to detect errors. It appears that the use of the ATU for proofreading gives the blind operator more independence. However, as stated above, the operator may still be somewhat dependent on sighted outside help. Using the Punctuation mode, however, does assist the operator to find errors in punctuation and in spacing that cannot be detected using the Pronounce mode only. (See Figure 3.)

Learning Total Mag-Card Equipment

The ATU is an invaluable tool in the instruction of the Mag-Card. The blind novice operator can become more familiar with the various keys on the host unit in a much shorter length of time. Using the Keyboard On mode, the basic features of the equipment could be taught with great ease. The special keys, margin setting, reading and recording cards, and other features become more familiar as the trainee uses the equipment.

- **Effect of Degree of Vision Loss on Usage:** The most beneficial effects were experienced by the totally blind students, as evidenced by their responses compared to those of partially sighted students. Some conflict of hearing and sight may have been a problem. Skills and procedures which depended upon partial vision interfered with the development of new methods of using the ATU. The conclusion from this limited study was that the learning rate was slightly affected by the presence of previously established, vision-oriented manual procedures.

- **Operating Difficulties Mentioned by Students:** Word clarity was the most prevalent problem. This could have been because of the Lanier Edisette transcriber being used. Headset volume was the apparent source of distortion. Several other comments were made:

- (1) Can't understand some words
- (2) Difficult to backspace
- (3) The pronunciation of abbreviations like Mr., Mrs., Dr., would help
- (4) "Spell mode" is confusing.

- **Additional Placement Opportunities:** A Mag-Card operator

who is proficient in the use of an ATU is certainly more valuable to an employer than one who is not. The most important factor is ability to work independently of sighted help. The operator using the IBM audio training tapes can also teach others the use of the machine. It is felt that this equipment is a powerful incentive for an employer to hire a visually handicapped person.

- **Overall Evaluation by Students:** In general, all of the comments from the students were positive. Most included such expressions as, "excellent," "no problems," "very pleasant," "easy to operate," "easy to learn," and "a great help to me in my work."

- **General Observations:** The pronunciation of some words, especially those that end in "ue," may cause some difficulty during proofreading. However, when a problem does occur, the operator may select the "Spell mode" for verification of the word or words.

A possible consideration would be for the user to create his or her own dictionary.

Implications

Results obtained from the study clearly indicate that the IBM ATU had a significant impact upon the learning process for visually handicapped word processors. Performance increased significantly in those criteria assessed in the study.

Based upon the present experiment, training in the proper use of the ATU definitely could have innumerable employment implications for the blind population. Currently, employment opportunities for the visually handicapped lag far behind those of their sighted counterparts; the unemployment rate among the blind population approaches 80 percent (Day, 1980). According to the Social Security Administration (O.R.S. Publication No. 016), over 120,000 blind persons receive some sort of Social Security Disability Income. This means that these individuals, if employed, earn less than \$334 each month. At the present time, qualified blind word processors have difficulty penetrating the job market.

With the advent of the ATU, greater numbers of blind and visually impaired persons would have an opportunity to obtain employment compatible with their vocational experiences and professional interests. Evidence from the present study supports the contention that blind individuals have the capability to master relevant tasks associated with word processing.

One distinct advantage of incorporating training on the ATU into vocational programs for the blind is the brief time required for students to develop proficiency. As shown by the present study, all five students exhibited marked improvement in their word processing skills after only 16 hours of training. It is likely that after a short training program with the ATU, blind persons can develop skills needed to function effectively as word processors. Hence, the employment opportunities for this population could be dramatically expanded with minimal training cost and time.

IBM is ideally suited to participate in projects of this nature, having a reputation for providing high quality service to those agencies and industries it serves. Employees will feel an increasing sense of self-sufficiency and self-esteem; the employer will have competent, dependable and loyal workers; and will benefit through the full utilization of human resources. ■

References

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